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ABSTRACT

A study to explore the effectiveness of the Columbus, Ohio, Public School Systems' compensatory education program on the reading and mathematics achievement of pupils in fourth, fifth, and sixth grades was conducted. Intent of the study was (1) To study the differential achievement reached by all eligible pupils; and (2) To analyze a selected number of control variables. A modified version of the effect parameter analysis developed by Coleman was used. Data were derived from the records held by the school system on fourth, fifth and sixth grade pupils. Data were organized by: (1) listing all pupils in these three grades enrolled in the program, (2) determining those pupils underachieving at least one year below grade level, (3) determining those underachievers who possess a measured intelligence 80 and who were enrolled in summer school, (4) classifying all pupils identified as meeting or not meeting the achievement criterion, and (5) classifying all pupils who attended. An analysis of the reading achievement grade scores and an analysis of the mathematics computational grade equivalency scores were performed. Results include: (1) The supportive services had no statistically significant impact on the reading achievement of pupils; (2) Among low intelligence enrollees, the mathematics program component was associated with a diminishing effect on participating pupils' reading achievement; and (3) Pupils who participated in the reading program components improved their reading achievement. (CK)

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AN EXPLORATORY STUDY OF THE EFFECTS OF COMPENSATORY EDUCATION ON THE READING AND MATHEMATICS ACHIEVEMENT OF INTERMEDIATE GRADE PUPILS

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RATIONALE AND BASIS FOR THE STUDY

A Problem Statement

An abundance of credible information on the effectiveness of compensatory education is lacking. All agencies local, state and federal involved in the process of administering compensatory education are responsible for this lack of useful information. Congress needs to know the actual effectiveness of ESEA on participating pupils versus the intended effectiveness of ESEA on its target populations.

In turn, each and every state needs to monitor each local school system in terms of their adherence to state interpretations of federal guidelines for ESEA and in terms of the state's guidelines for its own compensatory education legislation. To date this monitoring process has been spotty. In addition, each school system must comply with the Federal mandate for assessment. It also should develop a strategy for demonstrating accountability for its compensatory programs. Each local school system must demonstrate to its community, its state, and the federal government, that the system's compensatory education program is solving the problems it was intended to help solve.

The vast majority of LEA's cannot demonstrate the impact of compensatory education on the intended target populations. Many either do not possess the data or they lack the over-all design for analyzing extant data. Others, for some reason are unwilling to report what they do know. This does not obviate their obligation of being accountable to their particular communities.

The ultimate problem facing LEA's is in devising an approach to accountability for their compensatory education programs. However, for most, the solution of this total problem first involves solving lesser but perhaps more crucial problems. Many need to implement mechanisms which will provide the data necessary for the capability of becoming accountable, e.g., common testing programs for all pupils, longitudinal pupil record keeping systems, a host of program information keeping facilities, and, of course, a competent professional staff capable of performing these tasks. Some LEA's have already solved these problems and many more.

This more advanced group of LEA's needs to attack a higher level problem, but one still short of the ultimate. They need to analyze the data they have in order to determine (1) how well their compensatory education programs are performing, (2) who is being affected, (3) and the nature of the performance. Once this goal is

achieved, these systems have taken an initial step toward becoming accountable. Such an LEA is the Columbus Public School District, Columbus, Ohio

The Setting of the Study

This study utilizes Title I (ESEA) eligible pupils from the Columbus Public School District, Columbus, Ohio. During the 1968-69 school year the Columbus Schools operated a regular school program for approximately 110,000 pupils. Organizationally, 54,600 of these pupils were enrolled in grades one through six. Junior high grades seven through nine had an enrollment of 24,000 pupils, while the senior high level, grades ten through twelve, accounted for the balance, 31,400 pupils. The Columbus Schools operated 13 senior high schools, 26 junior high schools and 125 elementary schools. In addition, four schools were operated for the benefit of various exceptional children pupil populations.

Of the 164 school sites operated by the Columbus Public School District in 1968-69, 70 were classified as Title I (ESEA) eligible. These schools were those which had an ADC recipient enrollment percentage which was greater than the city-wide ADC enrollment percentage. Of these 70 eligible schools, 54 were elementary schools,

10 were junior high schools, and 6 were senior high schools. However, due to limited resources not all Title I eligible schools could be served by any one or combination of more than one Title I component. Thus, priorities for service had to be established.

These priorities for service were established by rank-ordering the schools on the absolute number of ADC recipients enrolled in each school. Priorities were established within each major school classification, i.e., elementary, junior high, and senior high. This process resulted in a total listing of 47 Title I eligible, participating schools. Of this total, 39 were elementary schools, 7 were junior high schools, and one school was a senior high.

Those schools which were Title I eligible were also eligible for State DP program components. Again, limited logistics prevented total implementation of any State DP component except health services. Thus, the highest priority elementary schools received service first, with other schools receiving service as funds and facilities became available.

Because this study was only concerned with grades four through six, only elementary schools were considered. In addition, only those schools which received the services of at least one Title I component were considered. This latter consideration is important in that the study was only interested in Title I eligible fourth, fifth, and sixth grade pupils in a Title I participating building.

These criteria set the school population at twenty-one schools.

Also, as the reader proceeds through this study, it will be disclosed in a later analysis that only ten of these twenty-one schools will be considered as a dependent variable. This will occur only because the analysis technique employed places a limitation on the school-by-school variable. Only those schools which received services from all five compensatory education components under study would fit the analysis routine employed. Thus, the sample of schools is shrunk further. However, on all variables except the school-by-school variable, pupils from all twenty-one participating schools were included for analysis purposes. The distribution of component services under consideration across these twenty-one schools is contained in Table 1.

Definition of Selected Terms

Attribute. . . A discrete variable, which may be dependent, independent, linking, mediating, or antecedent. In this study two types of attributes are employed, program attributes and pupil control variables. The former are variables associated with the compensatory education program under study. They are referred to as program components and are idiographic to actual compensatory education projects implemented by the Columbus, Ohio, Public Schools. In specific they are: Reading Improvement, Basic Mathematics Improvement, Elementary Counseling, Food Services, and Health Services.

TABLE 1

A DISTRIBUTION OF CONSIDERED COMPENSATORY EDUCATION COMPONENT SERVICES BY SAMPLED SCHOOL

	Compensatory Education Component				
School	Reading Improvement	Mathematics Improvement	Health Services	Food Services	Elementary Counseling
1	x	x	x	x	x
2	x	x	x	x	x
3	x	x	x	x	x
4	x	x	x	x	x
5	x	x	x	x	x
6	x	x	x	x	x
7	x	x	x	x	x
8	x	x	x	x	x
9	x	x	x	x	x
10	x	x	x	x	x
11	x	x	x		x
12-21	x		x		

Pupil control variables are variables or parameters associated with the pupil population under study. These variables are: pupil's intelligence, pupil's entry achievement level, pupil's grade level, poverty level of a pupil's school, the racial isolation of a pupil's school, and a pupil's individual school.

Effect. . . The underlying parameter expressing the relationship of an independent variable to a dependent variable. In this study the term effect parameter is used to denote the best estimator of such an effect. No implication of casuality is intended in the use of the term, though such a relationship may be possible.[22]

Random Shocks. . .Transition rate from one discrete state of an attribute to another which is not directly associated with expressed independent variables. It is analogous to unexplained variance for continuously distributed variables.[23]

Research Population. . .The research population employed in this study may be described as follows: it is the fourth, fifth, and sixth grade students of Title I (ESEA) participating schools in the (Title I eligible) Columbus, Ohio, Public School District who meet the following criteria:

(1) possessed a measured intelligence of $\geq$80

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[22] Op. Cit., Merriman, p. 22.

[23] Op. Cit., Merriman, p. 24.

(2) were underachieving a year below grade level in either mathematics computations or reading

(3) and were not enrolled in a 1969 summer public school program.

A Purpose and Objectives

The purpose of this study is to explore the effectiveness of the Columbus Public School's compensatory education program on the total reading and mathematics computational achievement of fourth, fifth, and sixth grade pupils during the 1968-69 school year. In specific terms, the objectives of this study are:

1. to examine the differential achievement attained by all Title I eligible fourth, fifth, and sixth grade pupils enrolled in Title I participating schools and
2. to analyze a selected a number of control variables associated with pupils who attained achievement success in order to investigate the possible relationships between pupil sub-groups and achievement success.

The attainment of the first objective is centered in an analysis of the pupil achievement effects associated with the various combinations of pupil participation in five compensatory education components.

The attainment of the second objective is concerned with possibly identifying alternative explanations for the associations between program attributes and individual pupil achievement success. These

posited alternatives of associative explanation are representative of questions which have been raised in research and educational literature for the past few years, e.g., the relationship of poverty and/or race to pupil achievement.

The basic nature of a generalized philosophy of compensatory education is perhaps the best theoretical or explaining structure for this study's first research objective. Basically, much of the early concern for educationally deprived pupils was limited to those pupils who were classified as being economically poor. This is probably best reflected by the initial wording of Title I of ESEA and by suggested guidelines for the submission of Title I program proposals. The original Title I legislation (Public Law 89-10) stated that:

> The total (Title I) federal allowance to a state was dependent on the total state expenditure per pupil divided by one-half times the number of children age 5-17 coming from families with annual incomes of less than $2,000, plus the number of children age 5-17 coming from families whose income from aid to families with dependent children was $2,000 or more.[24]

In addition, Section 105 (a) (1) of Title I requires that projects be designed to meet the needs of educationally deprived children living in school attendance areas with high concentrations of children from low-income families. By regulation the attendance areas with high

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[24] Op. Cit., U.S. Department of Health, Education, and Welfare, p. 24.

concentrations of children from low-income families are those areas which are equal to or greater than the average concentration for the (school) district as a whole.[25]

The scope of suggested low-income pupil needs which compensatory education programs might meet are also found in the State of Ohio's application forms. These needs range from preschool education through nutrition and health services. In attempting to construct and implement a relevant compensatory education program with appropriate scope, sequence, and balance, the Columbus Public Schools, Columbus, Ohio proposed several program components. These program components were funded by Title I monies and monies from the State of Ohio's Disadvantaged Pupil Fund.

The scope and sequence of these program components is contained in Table 2.

The five compensatory program components selected for inclusion in this study were (1) Reading Improvement, (2) Basic Mathematics Improvement, (3) Elementary Counseling, (4) Health Services, and (5) Food Services. These program components were selected for this study because the grade level sequence they served included the block

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[25] Criteria and Instructions for Title I, 1969 Application Forms, Ohio Department of Education, Division of Federal Assistance, Columbus, Ohio, 1969.

TABLE 2

THE INCIDENCE OF COMPENSATORY EDUCATION PROGRAM COMPONENTS IN THE COLUMBUS PUBLIC SCHOOL DISTRICT, COLUMBUS, OHIO; BY PROGRAM COMPONENT AND GRADE LEVEL SERVED; AS AT SEPTEMBER, 1968, AND SEPTEMBER, 1969

Program Components[c]	Grade Levels Served													
	Pre K	K	1	2	3	4	5	6	7	8	9	10	11	12
Pre-Kindergarten[a]	x													
Primary Language Development[a]		x	x	x	x									
Reading Improvement[a]						x	x	x	x	x	x	x	x	x
Basic Mathematics Improvement[a]						x	x	x	x	x	x			
Elementary Counseling[b]	x	x	x	x	x	x	x	x						
Health Services[b]	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Food Services[b]			x	x	x	x	x	x						
School Aides[b]	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Home-School-Community Agents[b]										x	x	x	x	x
Emotional Pupils Tutoring Service[b]						x	x	x	x	x	x	x	x	x

[a] Title I of ESEA Funded

[b] State DP Funded

[c] Funding Sources as at September, 1969

of grades used in this study: four, five, and six. In addition, the nature of their services seemingly spanned the range of high priority need-areas associated with low-income children.

The various combinations of the above program components may provide a partial explanation of pupil's achievement success. However, these component combinations only serve as a treatment description. There may be other explanations of pupil success or failure in the achievement domain. In a word, individual differences must be accounted for if a more complete explanation of pupil achievement is to be obtained. Listed below are the control variables employed in this study.

Achievement Entry Behavior. . .It is established that pupils vary in the degree to which they achieve in a cognitive area. In fact, it is a function of achievement tests to separate individual pupils into groups with varying achievement levels. One criterion used by teachers in selecting pupils to participate in a Title I program component was that the pupil be underachieving at least one year below his enrolled grade level. The intent of this pupil control variable is to cope with the assumption that a pupil who is more than one year below grade level in achievement would probably receive more individual instruction in order to increase his achievement to a point more in line with his grade level enrollment. These underachieving pupils have been the subject of much research over the last few years. Much has been said

about why they are underachieving. Authors have linked underachievement among economically disadvantaged pupils to many "causes" depending on the definition of being economically disadvantaged. Dave,[26] Hunt,[27] and John[28] have linked the underachievement to inadequate home environments. Wolfe[29] has stated this phenomena more specifically. He reports that parents are the most salient input or controlling feature of children's home environment.

Others, notably Deutsch[30] and Hess,[31] have been led by their research results to the conclusion that the prime "cause" of underachievement among poor children is inability to use standard language.

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[26]R. H. Dave, The Identification and Measurement of Environmental Process Variables that are Related to Educational Achievement, Unpublished Ph.D. dissertation, University of Chicago, 1963.

[27]J. Hunt, Intelligence and Experience, New York, Roland Press, 1963.

[28]Vera John, "The Intellectual Development of Slum Children: Some Preliminary Findings," American Journal of Orthopsychiatry, Vol. 33, 1963, p. 813-822.

[29]R. M. Wolfe, The Identification and Measurement of Environmental Process Variables Related to Intelligence, Unpublished Ph.D. dissertation, University of Chicago, 1963.

[30]Martin Deutsch, The Role of Social Class in Language Development and Cognition, New York, Institute for Developmental Studies, mimeographed, 1964.

[31]R. D. Hess, Educability and Rehabilitation: The Future of the Welfare Class, Committee on Human Development, University of Chicago, mimeograph, 1964.

This too is a phenomenon of the home, but is the one phenomenon which is most troublesome to the school. Normal language usage is crucial to normal advancement and achievement in most of our nation's schools.

Pupil Grade Level Enrollment. . .Underachievement has been demonstrated to increase at an increased rate as low-income pupils progress through the elementary grades. In addition, associated behaviors such as lack of a positive self concept and the possession of a negative attitude toward school, teachers, and school work are exhibited by pupils at an increasing frequency as they progress through the normal sequence of grade levels. The assumption operating in this pupil control variable is that it would be more difficult to bring upper intermediate pupils to grade level and keep them at grade level in terms of basic skills achievement.

Measured Pupil Intelligence. . .Individual variability in intelligence and its effects on learning has been a research question in volumes of studies. In this particular case it is also of interest. It is included as a variable because it is also a criterion for pupil participation in a Title I program component. A potential participant must attain a measured intelligence of at least 80. The possible effects of intelligence on high or low achievement is the rationale for its inclusion.

Racial Isolation. . .Recent research, i.e., Coleman,[32] has raised the question of the effects of racial isolation on pupil achievement. The assumption here is that pupils attending schools with a higher degree of racial isolation will tend to underachieve at a greater rate than pupils attending school with a lesser degree of racial isolation. There is another aspect to this assumption. A pupil enrolled in Title I program component spends much more time in his regular classroom than he does in compensatory component services. In a school with a higher degree of racial isolation it would be more difficult for a Title I program component to have any lasting effect on individual pupil's achievement.

Poverty Level. . .All of what was stated in the rationale for the inclusion of the racial isolation question also applies to this question. However, there is a separate assumption operating in this case. Local educational agencies are urged by federal guidelines to select Title I eligible schools on the basis of the number of low-income pupils between 5-17 years of age residing in that school's attendance area. The guidelines do not however require that only low-income pupils be eligible to receive services.

On a collective basis, schools with a high degree of low-income attendance area residents also have a high degree of racial isolation.

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[32] James S. Coleman, et. al., Equality of Educational Opportunity, 2 Vols., Publication of the National Center for Educational Statistics, OE 38001, Washington, D.C., Government Printing Office, 1966, p. 1.

These schools tend to have a heavy enrollment of black pupils. These schools also score lower on achievement tests than those with a lower degree of low-income residents and/or black pupils. Coleman demonstrated that these variables affect pupil achievement. The question is whether or not poverty also is operating in the Columbus Public Schools Compensatory Education Program.

School. . .Dyer, Linn, Patton[33] and others have postulated that the focus of exploratory studies in education ought to first be the various school buildings having similar programs or program component combinations. The assumption operating in this instance is that a school building is the incident of many behavioral variables operating in complex interactional manners. This phenomena most assuredly has varying effects on pupil achievement. Also being assumed is the fact that some school building situations more often than not affect positive achievement even among low-income pupil populations. However, in a summative study these positive effects are often negated by other school buildings whose pupils perform less well. Through the use of this question, relative pockets of compensatory education achievement success can be located for future investigation.

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[33] Henry Dyer, Robert Linn, and Michael Patton, Feasibility Study of Educational Performance Indicators, A Final Report to the New York State Education Department, Princeton, New Jersey, Educational Testing Service, 1969.

Limitations and Scope of the Study

This study, dealing as it does with the achievement of Title I of ESEA eligible fourth, fifth, and sixth grade pupils of a single school system as well as being exploratory in nature, does have specific constraints. In this first instance, the nature of the compensatory program being studied might not exist in any other educational system. In a word, the nature of the treatment being researched may be idiosyncratic to the Columbus, Ohio, Public School District.

Another limitation is found in the population of pupils being researched. They consist only of fourth, fifth, and sixth grade pupils of a single school district and are representative of only a subpopulation of that school district's total Title I eligible population. In addition, the fact that only Title I eligible pupils in Title I eligible participating school buildings were researched is a limiting factor. A population of pupils whose intelligence range is 80 to 121, who are all underachieving at least one year behind grade level enrollment, and enrolled in predominantly low income schools cannot be considered to be representative of all pupils. They might not be representative of all poor children as there is much variance on this variable from one community to another, e.g., the level of poverty associated with New York City's Bedford-Styversynt area is perhaps much lower and more pervasive than the

lowest level of poverty found in the Columbus, Ohio, Public School District.

It is hoped, however, that the size of the population being researched will lend credibility to the study results in spite of the aforementioned limitations.

Justification

The importance of this study has already been alluded to in the problem statement. It is first assumed that the information provided by this study will be of interest and value to administrators and legislators throughout the nation.

It is also assumed that this study will provide the Columbus, Ohio educational community with a base of information on the achievement effectiveness of a selected number of components of their school system's compensatory education program.

Furthermore, it is assumed that the results of this study will serve as input for much future evaluation and research on compensatory education in the Columbus, Ohio, Public School District as well as elsewhere.

An assumption serves as the basis for the study's justification as well. The concept of compensatory education will continue for many years to come. The Federal Government will continue to appropriate large sums of money for its support and the various state governments will increase their fiscal allocations to compensatory education. The

evaluation requirement will remain; and so will criticism of the concept of compensatory education.

Within this context it is apparent that educationists must be prepared to report the effectiveness of compensatory education programs.

To date USOE has provided funds for programs, guidelines for utilization of the funds, and mandates for evaluation. The evaluation mandate has not produced the information base necessary to answer even fundamental questions. The critics go virtually unchallenged. This study is an attempt to begin to supply data and information on the effectiveness of compensatory education: data and information for gauging program achievement success in the Columbus, Ohio, Public Schools. Data and information for initiating corrective program change in order to attain more achievement success will also be supplied by this study.

Further, if compensatory education programs are to be refined and replanned on the basis of relevant, timely information, LEA's must continue to evaluate their programs. To date no federal or state report has provided data to individual school districts which has given LEA's a basis to replan compensatory curricula on a rational basis. Studies such as this are still required. They will perhaps always be required if other agencies do not begin to provide data and/or information which local program administrators can idiographically relate to their local programs.

Summary

This section provided a rationale for this study. The federal efforts aiding education through Title I of ESEA were described. The appended evaluation mandate and its intent were also examined. Congress legislated an evaluation requirement in an effort to construct an information-communication system which would provide feedback to them as to the relative effectiveness of the programs funded with federal monies. This system failed. As the critics of compensatory education voiced their perceptions and reported their data it became evident that the federal level was not able to rebut.

The federal attempts at improving their information-communication system were also described in this chapter. Though the data collection and analysis system became more and more sophisticated the level of reporting remained rather static. The critics of compensatory education increased in volume and frequency.

The general problem of education's inability to respond to its critics was further examined. It was reported that the federal level of evaluation efforts must be augmented by more sophisticated evaluative efforts by the LEA's which receive Title I funds. At this juncture the general LEA evaluation strategy, i.e., project by project and fiscal year by fiscal year, was described. The research problem for this study was then isolated; that problem being that credible information on the effectiveness of compensatory education is lacking.

The purpose of this was presented in three questions: (1) how well is the Columbus, Ohio, Public School's compensatory education program performing, (2) who is being affected, and (3) what is the nature of the program's performance. This three phase purpose was further explicated in the following objectives:

1. to examine the differential achievement attained by all Title I eligible fourth, fifth, and sixth grade pupils enrolled in Title I participating schools.
2. to analyze a selected a number of control variables associated with pupils who attained achievement success in order to investigate the possible relationships between group differences and achievement success.

The justification for this study was rooted in a series of assumptions. Briefly, it was posited that compensatory education would continue as a concept and would continue to receive large amounts of federal assistance. It was also postulated that the evaluation mandate would remain and be in need of much methodological improvement if it was to collect and communicate credible information for program change and improvements.

RESEARCH PROCEDURES

Introduction

This section describes the overall methodology of the study, including methods of data collection, data organization, statistical treatment (analysis and significance testing), and limitations in data interpretation.

This study employs a modified version of the effect parameter analysis developed and applied by Coleman.[1] The modification was developed by Merriman in his Study of the States Reports on Title I, Elementary and Secondary Education Act.[2] He is apparently the only person who has ever used the analysis modification and has utilized it only once. It was therefore necessary to rely heavily on his logic and methodological framework in the development of this study.

Collection of the Data

The sources of data for this study are confined to the data and

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[1] James Coleman, Introduction to Mathematical Sociology, Free Press of Glencoe, New York, 1964.

[2] Howard Merriman, A Study of the States' Reports on Title I, Elementary Secondary Education Act of 1965, Unpublished Ph.D. dissertation, The Ohio State University, Columbus, Ohio, 1968.

records which exist within the Columbus, Ohio, Public School District's information base on fourth, fifth, and sixth grade pupils. Specifically the following sources of data were utilized: (1) pupil centered, computer based listings of individual pupil performance on The California Test of Basic Skills as at October, 1968, and October, 1969, (2) pupil centered, computer based listings of individual pupil performance on The California Test of Mental Maturity as at October, 1969, (3) The Columbus Public Schools' Title I Pupil Census and Program Enrollment Form, (4) File records maintained by the evaluation and program staff of the Columbus, Ohio, Public School District's Health Centers Component, (5) File records maintained by program staff of the Columbus, Ohio, Public School District's Food Services Component, (6) administrative records developed and maintained by the administrative staff of the Columbus, Ohio, Public School District's Department of Special Program Development, and (7) The 1969 Columbus School Profile.

Organization of the Data

Data organization consisted of the following activities: (1) listing all pupils enrolled in the fourth, fifth and sixth grades of Title I schools participating in the Columbus, Ohio, Public School District's reading improvement component, (2) determining those pupils underachieving at least one year below grade level in reading and/or mathematics computations achievement as at October, 1968, (3) determining those underachievers who possessed a measured intelligence $\geq$ 80 and

who had not been enrolled in the 1969 summer school, (4) classifying all pupils identified thus far as meeting or not meeting the achievement success criterion and (5) classifying all pupils who attained the achievement success criterion on the following control variables:

A. Entering achievement level.

B. Measured intelligence.

C. Grade level enrollment.

D. Racial isolation of the pupil's school.

E. Poverty level of the pupil's school.

F. School the pupil attended.

A discussion of these procedures follows. The construction of the control variables in data organization activity number five is discussed in the following section.

A Discussion of the Control Variables

The secondary study objectives which relate to the second major research objective described in Chapter I require that the extent of the following control variables be determined: Entering Achievement Behavior, Measured Intelligence, Grade Level Enrollment, Racial Isolation of Schools, Poverty Levels of Schools, and School Building.

Entering Achievement Behavior. . . A simple dichotomy was utilized for both a pupil's entering achievement level in reading and/or mathematics computation. Pupils were classified in terms of grade equivalency scores as being $\geq 1.0 < 2.0$ or ≥ 2.0 years below grade level. For discussion

purposes these two categories of pupils will be termed one year and two year underachievers.

Measured Pupil Intelligence. . . In this instance a trichotomy was employed. Pupils were classified in terms of intelligence quotients as being $\geq 80 < 95$, $\geq 95 < 110$, or ≥ 110.

Grade Level Enrollment. . . Pupils were classified according to their October, 1968, grade enrollment. A pupil was either a fourth, fifth, or sixth grade enrollee. There were no non-graded conflicts to compromise.

Racial Isolation of Schools. . . A rank-ordering of schools by the percentage of black pupil enrollment demonstrated a dichotomous decision-rule. Schools considered to be high in racial isolation were those whose black pupil population was $\geq$ 89 per cent of their total enrollment. Schools considered to be low in racial isolation were those whose black pupil enrollment was $\leq$ 59 per cent of their total enrollment. The rationale employed was that a breaking point occurred in the rank-ordering of schools on this variable. The rank ordering is contained in Table 3.

Poverty Level of Schools. . . A rank-ordering of schools by the percentage of pupil enrollment who were members of families receiving income from Aid to Dependent Children funds (ADC) also demonstrated a dichotomous decision rule. Schools considered to be high poverty schools were those whose ADC enrollment was $\geq$ 35 per cent of the school's total enrollment. Schools classified as being low poverty schools were those whose ADC enrollment $\leq$ 30 per cent. The rank ordering is contained in Table 4.

School Buildings. . . This control variable was determined by utilizing only those schools which were served by all five compensatory education program components being researched in this study (see description in Chapter I). Pupils were classified as to the school building they attended while they were participating in the various program components. The school name served as the classifying locus. The process resulted in ten separate units for this control variable.

Criteria For Program Component Enrollment

The focus of this study is to explore the possible effects of various combinations of compensatory program component enrollment on individual pupil reading and mathematics computational achievement. Thus, a pupil could be enrolled in more than one component. It became necessary to establish criteria for determining sufficient enrollment or participation. This operation was performed so that pupils would be classified as a program component enrollee only if sufficient exposure to that program component's "treatment" was experienced. These participation criteria are contained in Figure 3.

Test for the Independence of the Control Variables

The control variables were then tested for independence. As Merriman states: "The conditions specified through elaboration by (control) variables may have had common anecedents, if these attributes

TABLE 3

THE RANK ORDERING OF TITLE I ELIGIBLE PARTICIPATING SCHOOLS AS TO THEIR PERCENTAGE OF BLACK PUPIL ENROLLMENT, AS AT OCTOBER, 1968

School	Percentage of Black Pupil Enrollment	
1	100%	
2	100%	
3	99%	
4	99%	
5	96%	
6	96%	
7	94%	High
8	94%	
9	92%	
10	90%	
11	90%	
12	89%	
13	59%	
14	55%	
15	44%	
16	34%	
17	30%	Low
18	24%	
19	18%	
20	14%	
21	12%	

TABLE 4

THE RANK ORDERING OF TITLE I ELIGIBLE PARTICIPATING SCHOOLS
AS TO THEIR PERCENTAGE OF ADC ENROLLMENT
AS AT OCTOBER, 1968

School	Percentage of ADC Enrollment	
1	63	
2	56	
3	50	
4	48	
5	46	High
6	45	
7	36	
8	36	
9	35	
10	35	
11	30	
12	29	
13	28	
14	28	
15	26	
16	26	Low
17	24	
18	24	
19	24	
20	22	
21	15	

were not independent."[3] A matrix of chi-square values was determined for the six control variables, using chi-square as follows:[4]

$$X^2 = \sum_{i=1}^{k} \frac{(Oi - Ei)^2}{Ei}$$

O_i = observed number of cases categorized in the i nth category

Ei = expected number of cases in the i nth cagegory under the null hypothesis

$\sum_{i=1}^{k}$ sum over all (k) categories

The obtained chi-square values were tested for statistical significance by entering the obtained values in a table of critical chi-square values with appropriate degrees of freedom. The matrix and an interpretation of same is found in Chapter IV.

Data Analysis and Statistical Treatment

The focus of this study is grade equivalency scores of fourth, fifth, and sixth grade pupils with a measured intelligence of _ 80, who are attending Title I eligible participating schools, and who as at Octob er, 1968, were underachieving at a rate which made them eligible for Title I program component enrollment, i.e., $\geq$ one year below grade level expectancy. These pupils were classified as to their participation in five compensatory education program components as well as according

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[3] Op. Cit., Merriman, p. 63-64.

[4] Sidney Siegel, Non Parametic Statistic, McGraw-Hill, New York, 1956, p. 43.

Title I Reading Improvement	five months of continuous enrollment
Title I Mathematics Improvement	five months of continuous enrollment
Food Services	five continuous months of participation
Health Services	diagnosis visitation and return treatment
Elementary Counseling	counseling indication of having been enrolled in an intensive counseling program

Figure 3
The by Project Listing of Sufficient Participation Criterion Employed in Determining the Level of Pupil Participation in Each Target Compensatory Education Project.

to certain control variables. There was, however, an additional procedure involved before actual statistical analysis could be initiated.

In order to apply the analysis technique selected for this study a criterion for success in reading and mathematics computation had to be determined, as well as the aforementioned decision rule which would separate participants from non-participants. Test-retest achievement scores were utilized to answer the concern applicable to individual pupil achievement.

As previously mentioned, the population for this study was selected by the use of October, 1968, reading and mathematics computation grade

equivalency scores from appropriate subtests of the California Test of Basic Skills. To determine absolute achievement success attained by each selected pupil, appropriate subtest scores from the California Test of Basic Skills were recorded as at October, 1969. These scores were not collected simultaneously with the termination of the "treatments" experienced by pupils enrolled in the various compensatory education program components being researched.

Answering the success criterion concern for achievement gains was accomplished in the following manner.

Each individual's October, 1968, grade equivalency achievement scores in reading and mathematics computation were arrayed, then the number of months each pupil was enrolled in mathematics and in reading was determined. For each month enrolled, one-tenth of a grade placement was added to the pupil's October, 1968, mathematics and reading scores. For example, if a fourth grade pupil's October, 1968, grade equivalency in total reading was equal to 2.4 and if he had been enrolled in reading for six months, the 2.4 would be added to .6. The resulting sum, 3.0, would be considered as this pupil's October, 1969, expected grade equivalency score in total reading achievement.

The final result was an array of expected achievement scores for reading and mathematics computation as at October, 1969, based on achievement as at October, 1968.

The final procedural step was to compare each pupil's 1969

expected grade equivalency achievement score with that pupil's actual grade equivalency score. Any pupil who met or surpassed his expected score met this study's success criterion. This criterion setting process is rooted in the following rationale.

The 1968-69 achievement results of grades 4-8 in the Columbus Public Schools indicated that 53 per cent of all sixth grade pupils were not meeting the national norm in reading. This percentage of pupils was much greater in Title I participating schools.

The library shelves are full of works which cite data reflecting the problems of the economically poor, underachieving pupil. An inadequate home environment promotes poor language facility, which retards the individual's ability to learn. This three phase chain usually is associated with poor motivation for school work, negative attitudes toward school related phenomena, poor self-concept, low grades, infrequent attendance, poor achievement, early dropping out of school.

The covariances are, of course, rampant in such a complex set of factors. However, most authors agree that if these conditions continue without relief a pupil caught-up in this vortex of barriers to school

success is most likely going to underachieve at a cumulative rate as he moves through the grades.[5,6] This cumulative rate is graphically demonstrated in Figure 4.

This data can only be gained through a rather extensive longitudinal study. However, most research, including this study, cannot include such a data collection mechanism. Therefore, the amount of underachievement associated with a given individual at a given grade enrollment must be estimated.

Based on this rationale the previously described criterion setting process was developed and utilized in determining which pupils met the performance criterion.

It is now possible to describe the data analysis within the overall conceptual framework of the study. Figure 5 contains a tabular representation of this conceptual framework. Note that the horizontal axis of the figure is a hierarchical matrix of dichotomous independent variables as column headings. These enumerations indicate the presence or absence of a pupil's participation in various programs. The possible combinations are indicated by the P subscripts in the various cells. Also, note that the vertical axis is composed of polychotomous independent variables (a proportion of pupils under a control variable

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[5] B. S. Bloom, Stability and Change in Human Characteristics, New York, Wiley and Sons, 1964.

[6] Martin Deutsch, "The Disadvantaged Child and the Learning Process," Education in Depressed Areas, New York, Teachers College, Columbia University, 1963, pp. 167-180.

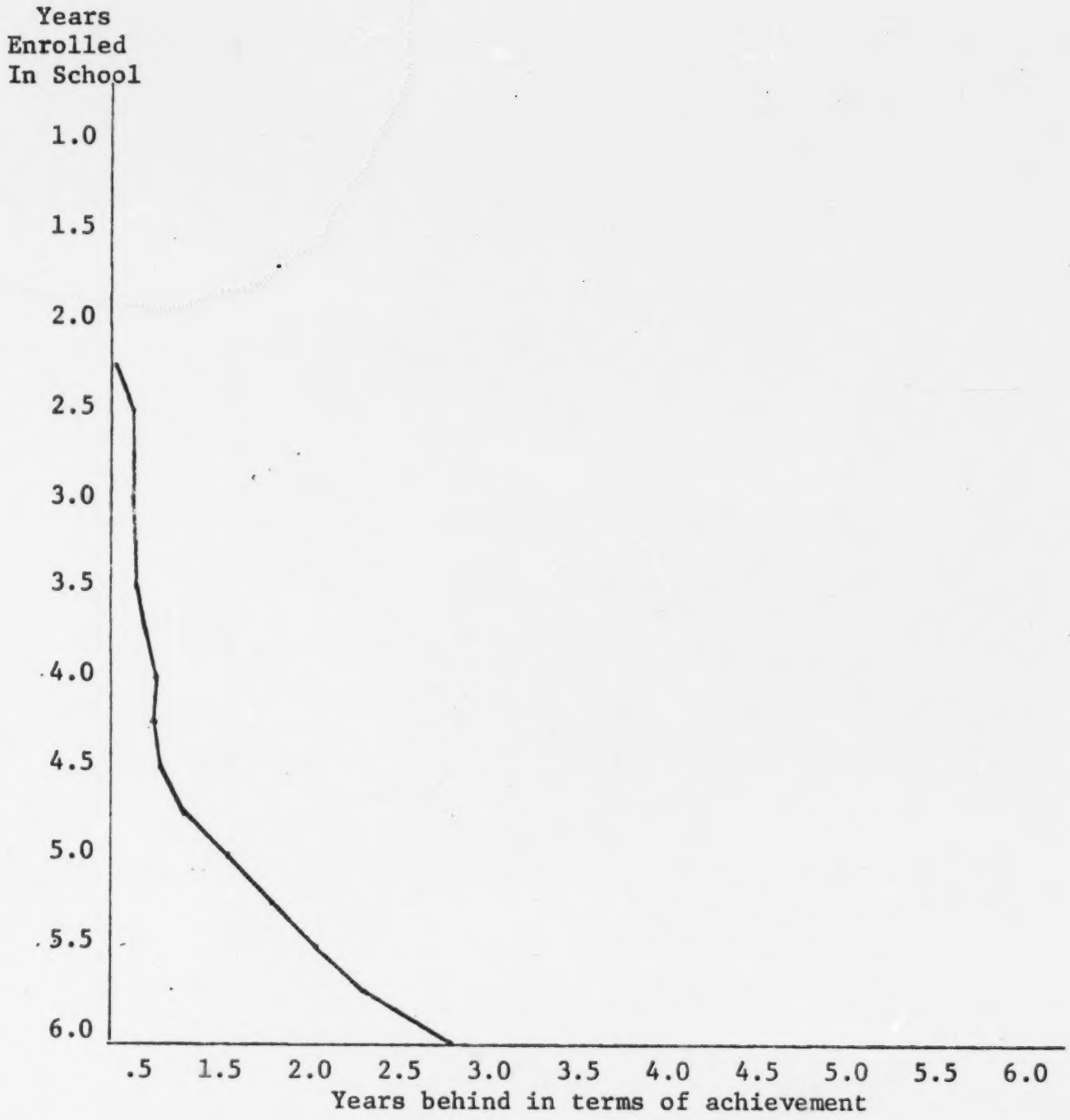

Figure 4
A Performance Curve Depicting the Hypothesized Cumulative Underachievement of Economically Disadvantaged Pupils as They Progress Through the Elementary Grades

condition who met the achievement success requirements.)

Using this conceptual framework and classifying the successful pupils along the determinants of each control variable, it was possible to establish effect parameters.[7] The establishment of these parameters permitted the analysis of the effects of the attributes contained in each control variable. It is possible to derive effect parameters for each attribute within a control variable, as well as error terms (Coleman's P random shock),[8] The model equation for this analysis is:

$$A_1 + A_2 + A_3 + A_4 + A_5 = 1 - (r + s)$$

where A_1 = reading enrollment, A_2 = mathematics enrollment, A_3 = food services participation, A_4 = health services participation, A_5 = elementary counseling enrollment; r = random shock toward meeting the achievement success criterion by pupils; s = random shock away from meeting the achievement success criterion.

Utilizing the P_i notations found in Figure 5, the main effects of the various compensatory education program components can be theoretically estimated. The estimates of these main effects are derived by the following linear models:

(Reading enrollment)

$$A_1 = 1/16\ (P_{12345} - P_{2345}) + (P_{1345} - P_{345}) + (P_{1245} - P_{245})$$

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[7] James Coleman, Introduction to Mathematical Sociology, Free Press of Glenco, New York, New York, 1964.

[8] Ibid., p. 107.

Reading 1	READING (1)															
Mathematics 2	MATH								NO MATH							
Food Services 3	FS (1)				NFS (0)				FS (1)				NFS (0)			
Health Services 4	HS (1)		NHS (0)		HS (1)		NHS (0)		HS (1)		NHS (0)		HS (1)		NHS (0)	
Counseling 5	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC
Cell[a]	p 12345	p 1234	p 1235	p 123	p 1245	p 124	p 125	p 12	p 1345	p 134	p 135	p 13	p 145	p 14	p 15	p 1

Reading 1	NO READING (0)															
Mathematics 2	MATH (1)								NO MATH (0)							
Food Services 3	FS (1)				NFS (0)				FS (1)				NFS (0)			
Health Services 4	HS (1)		NHS (0)		HS (1)		NHS (0)		HS (1)		NHS (0)		HS (1)		NHS (0)	
Counseling 5	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC	EC	NEC
Cell[a]	p 2345	p 234	p 235	p 23	p 245	p 24	p 25	p 2	p 345	p 34	p 35	p 3	p 45	p 4	p 5	p 0

Figure 5 - The Project Participation Pupil Classification Matrix

a-- the presence of digit in this cell row indicates participation in a project. A 1 indicates participation in reading, a 2 participation in mathematics, a 3 participation in food services, a 4 participation in health services, and a 5 participation in elementary counseling. A lack of a digit indicates no participation for that project.

$$+ (P_{145} - P_{45}) + (P_{1235} - P_{235}) + (P_{135} - P_{35}) + (P_{125} - P_{25})$$

$$+ (P_{15} - P_5) + (P_{1234} - P_{234}) + (P_{134} - P_{34}) + (P_{124} - P_{24})$$

$$+ (P_{14} - P_4) + (P_{123} - P_{23}) + (P_{13} - P_3) + (P_{12} - P_2) + (P_1 - P_0)$$

(Mathematics enrollment)

$$A_2 = 1/16 \ (P_{12345} - P_{1345}) + (P_{2345} - P_{345}) - (P_{1245} - P_{145})$$

$$+ (P_{245} - P_{45}) + (P_{1235} - P_{135}) + (P_{235} - P_{35}) + (P_{125} - P_{15})$$

$$+ (P_{25} - P_5) + (P_{1234} - P_{134}) + (P_{234} - P_{34}) + (P_{124} - P_{24})$$

$$+ (P_{24} - P_4) + (P_{123} - P_{13}) + (P_{23} - P_3) + (P_{12} - P_1)$$

$$+ (P_2 - P_0)$$

(Food Services participation)

$$A_3 = 1/16 \ (P_{12345} - P_{1245}) + (P_{2345} - P_{245}) + (P_{1345} - P_{145})$$

$$+ (P_{345} - P_{45}) + (P_{1235} - P_{125}) + (P_{235} - P_{25}) + (P_{135} - P_{15})$$

$$+ (P_{35} - P_5) + (P_{1234} - P_{124}) + (P_{234} - P_{24}) + (P_{134} - P_{14})$$

$$+ (P_{34} - P_4) + (P_{123} - P_{12}) + (P_{23} - P_3) + (P_{13} - P_1)$$

$$+ (P_3 - P_0)$$

(Health Services participation)

$$A_4 + 1/16 \ (P_{12345} - P_{1235}) + (P_{2345} - P_{235}) + (P_{1345} - P_{135})$$

$$+ (P_{345} - P_{35}) + (P_{1245} - P_{125}) + (P_{245} - P_{25}) + (P_{145} - P_{15})$$

$$+ (P_{45} - P_5) + (P_{1234} - P_{123}) + (P_{234} - P_{23}) + (P_{134} - P_{13})$$

$$+ (P_{34} - P_3) + (P_{124} - P_{12}) + (P_{24} - P_4) + (P_{14} - P_1) + (P_4 - P_0)$$

(Elementary Counseling enrollment)

$$A_5 = 1/16\ (P_{12345} - P_{1234}) + (P_{2345} - P_{234}) + (P_{1345} - P_{134})$$
$$+ (P_{345} - P_{34}) + (P_{1245} - P_{124}) + (P_{245} - P_{24}) + (P_{145} - P_{14})$$
$$+ (P_{45} - P_4) + (P_{1235} - P_{123}) + (P_{235} - P_{23}) + (P_{135} - P_{13})$$
$$+ (P_{35} - P_3) + (P_{125} - P_{12}) + (P_{25} - P_2) + (P_{15} - P_1)$$
$$+ (P_5 - P_0)$$

These equations represent the effects due to attributes 1, 2, 3, 4, 5, or main effects A_1, A_2, A_3, A_4, or A_5 present with all others absent.[9]

Significance Test for Effect Parameters

The results of this main effects analysis were then tested for being significantly different from zero. Coleman[10] states the following logic.

> .. Since the proportions for each cell are binomially distributed, their difference (paired comparisons) are approximately normally distributed, with variance equal to the sum of the separate variances. In the case of m dichtomous variables, the variance of effect parameter a_i may be written

$$\sigma_{a_i}^2 = \frac{\sigma_m}{2^{2m-2}}$$

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[9] Op. Cit., Merriman p. 66.

[10] Op. Cit., Coleman, p. 206.

where a_i^2, is the sum of m variances of p's. The probability that effect parameter A_i could have been zero or negative in the population was tested by finding $Ui = \frac{ai - 0}{\sigma a_i}$, where Ui is the standardized normal deviate.

A table of the standardized cumulative normal distribution was then used to find the probability that a value of Ui could have occurred by chance.

For purposes of this research, being basically exploratory in nature, a decision rule of $p \leq .10$ was used to decide if a given A_i was statistically significantly different from zero or not.

Control Variable (dependent Variable) Analysis

As previously described, and as depicted in Figure 5, the variables listed along the vertical axis are polychotomous dependent variables. The first such variable simply asks the question, "What proportion of students in each cell met the achievement success criterion?" The questions which follow test this proportion "for consistency by further elaboration."[11]

The pupil control variables were then tested against the proportions of successfully achieving pupils determined by the analysis for question #1. These variables were all dichotomous in that a pupil either possessed the attribute or did not. Using this procedure, effect parameters for each program attribute were determined for each pupil control variable.

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[11] Op. Cit., Merriman, p. 70.

These control variables were tested for statistical significance in the same manner as effect parameters $A_1 \ldots A_5$. The essential question was whether the obtained proportions were significantly different from zero. A value of $p \geq .10$ was utilized as a decision-rule. The differences between effect parameters were also tested for statistical significance.

> The test is analogous to the test for differences between proportions, and is based on the assumption that differences between bionomially distributed variables are approximately normally distributed.[12]

The following formula[13] was used to yield a standardized normal deviate of the difference between a given pair of effect parameter values.

$$U_i = \frac{a_{i_2} - a_{i_2}}{\sigma a_i}$$

Where:

1. $a_i = \sqrt{\Sigma \sigma^2 p_{ij/ij}}$

2. $\Sigma \sigma^2 p_{ij/ij} = \Sigma \sigma^2 p_{i1} + \Sigma \sigma^2 p_{i2}$

3. $\sigma^2 p_i = p_i (1 - p_i)/n_i$

This test aids in answering whether a control variable sorts a group of pupils into sub groups which are significantly different from one another. A decision-rule of $p \geq .10$ was employed.

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[12] Op. Cit., Merriman, p. 71.

[13] Op. Cit., Coleman, pp. 205-207.

> Comparisons made in this manner take into account the differences in number of [pupils] in each group, due to the weighting which is used in the pooling of variances. This provides a screen whereby differences which are largely due to the size of the n will not be spuriously (statistically) significant.[14]

Lastly, each pupil control variable sub group's effect parameter was tested against the total groups effect parameter. The U_i significance test was utilized as $p \geq .10$ was again employed as a decision rule for statistical significance.

All these aforementioned procedural steps were performed twice: once for a field of reading achievement data, and once for a field of mathematics computation achievement data.

Limitations of Data Interpretation

The most salient sources of potential error within the data for this study are as follows:

1. The source of pupil performance data for this study was a nationally normed achievement test. The test, re-test raw scores of pupils selected for this study were converted to grade equivalency scores. Finally, the pupils selected for this study were known underachievers and residents of school attendance area. depicted as racially isolated and low-income impacted areas. These three facts are laden with problems:

    a. The grade equivalency scores of pupils on this test are valid only to the extent that their peers were included in the national norming sample. Although the test employed

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[14] Op. Cit., Merriman, p. 72.

was leveled to the grade range 4-6, the pupils selected for this study scored at the lower extreme of the grade equivalency distributions. The error in producing these scores does increase as one moves away from the central tendency.

b. A change in levels of the California achievement battery was necessitated from the October, 1968, test to the October, 1969, retest scores for the 1968 sixth grade pupils who articulate to the seventh grade in 1969. Because these pupils entered the seventh grade and were administered a higher level of the achievement battery, their scores may have been depressed by the increased discrimination power of the test items. The remedial instruction received may have cemented these pupils' ability to operate at the elementary level but might not adequately have prepared pupils for junior high instructional content. The potential problem exists.

2. The criterion for achievement success employed in this study sets a ceiling on the magnitude of pupil achievement change considered for success classification. Pupils achievement change varied greatly both above and below the individual criterion rule employed. Thus, the actual variance of achievement change scores has been truncated and is lost information.

3. In the instances of the intelligence; underachievement, racial isolation, and poverty level pupil control variables, somewhat continuous variables were dichotomized. This also may have resulted in a loss of information.

ANALYSIS OF THE DATA

Introduction

This section presents the analyses of the data germane to this study. Two separate analyses are performed: (1) an analysis of the reading achievement grade equivalency scores and (2) an analysis of the mathematics computational grade equivalency scores. Each analysis includes: (1) the analysis of effect parameters for the five program attributes under consideration, (2) a test for the independence of the control variables under study, and (3) the analysis for the elaboration of the control variables.

Analysis of Effect Parameters for Program Attributes on Reading Achievement

The reading achievement of participating pupils was analyzed by the procedures outlined in the previous section. Each eligible and/or participating pupil was classified as to the types of program components in which that pupil had participated, including no participation in any component. (See Figure 5) Pupils in each combination were then classified as either attaining or not attaining the achievement success criterion. This classification of pupils provided the basis for computing effect parameters for the program attributes. These effect parameters as well as their probability values are contained in Table 5.

TABLE 5

EFFECT PARAMETERS FOR PROGRAM ATTRIBUTES ON READING ACHIEVEMENT

	Program Attributes				
	Reading a_1	Mathematics a_2	Food Services a_3	Health Services a_4	Elementary Counseling a_5
Effect	+.178	+.043	+.026	-.034	+.031
Pr. (ai-0)	.0256	.3192	.3859	.3357	.3669

Pr. => .10

The effect parameter analysis indicates that only the compensatory education program's reading component was associated with a statistically significant effect on reading achievement (+.178). The other program components demonstrate no overall effect on pupils' reading achievement. Although reading performance across all pupils was enhanced by participation in the mathematics, food services, or elementary counseling program components, the positive effects were not large enough to be significant.

The differences among effects were not tested for statistical significance as only one was significantly different from zero.

This analysis does not indicate the magnititude of gains in reading performance of pupils. It does, however, indicate that pupils who are underachievers in reading skills are more positively affected toward becoming reading achievers, if they participate in the reading program component. This is, of course, a highly anticipated outcome.

Results of the Testing of the Independence of Control Variables for Reading Achievement

As stated in Chapter III, the main effect parameter in both reading and mathematics computational achievement would be further elaborated by control variables. These variables are: (1) the entering achievement level of the participating pupils (2) participating pupils' grade level enrollment, (3) participating pupils' measured intelligence, (4) the degree of racial isolation (proportion of Black enrollees) of participating pupils' schools, (5) the degree of poverty (ADC caseload membership) of participating pupils' schools, and (6) the schools participating pupils attended. These variables were explicated in Chapter III and the rationale for their use is contained in Chapter I.

These control variables in the reading achievement analysis were treated for independence via the previously discussed chi-square technique. The chi-square values obtained are contained in Table 6. A decision rule of probability .01 was employed to determine statistical significance. As the tabled chi-square data indicate seven of the fifteen pairs of control variables were statistically significantly related:

	X^2	df
Racial Isolation with each School	54.07	1
Poverty Level with each School	42.60	1
Grade Level with Intelligence	26.38	4
Grade Level with Poverty Level	26.30	2
Intelligence with Racial Isolation	138.51	2
Intelligence with each School	53.03	18
Entering Achievement with each School	50.58	9

These variables are moderately related and could be the resultant of an antecedent condition. When the effect parameters for reading achievement are elaborated by the above variables, the reader should recall that they are related and that any data interpretation will be somewhat restricted by this association.

Elaboration of Effect Parameters by Control Variables for Reading Achievement

This elaboration procedure was described in the procedures section. The original effect parameters were further analyzed in order to determine under what conditions they were enhanced or diminished. The results of this secondary analysis are contained in this section. The analysis is presented for each of the control variables. The decision rules used in interpreting the data are as follows:

(1) Effect parameters were considered to be greater than zero if their probability was $\geq .10$ by a two-tailed test for significance.

(2) Differences between effect parameter values were considered to be greater than zero if their probability was $\geq .10$ by a two-tailed test for significance.

The data germane to each control variable is presented in tabular form. Each original effect parameter is presented as well as its probability. The data associated with each condition of the control variable is also presented with differences between the elaborated effect parameter and the original effect parameter as well as its

TABLE 6

CHI-SQUARE VALUES OF CONTROL VARIABLES
FOR READING ACHIEVEMENT[a]

Control Variable	(1)	(2)	(3)	(4)	(5)	(6)
(1) Grade Level	-	26.38[b] df=4	.30 df=2	5.10 df=2	26.3[b] df=2	28.32 df=18
(2) Intelligence			.61 df=2	138.51[b] df=2	.96 df=2	53.03[b] df=18
(3) Entering Achievement			-	.04 df=1	6.09 df=1	50.58[b] df=1
(4) Racial Isolation				-	1.74 df=1	54.07 df=1
(5) Poverty Level					-	42.60[b] df=1
(6) School						-

[a] Pr. = $\geq$ .01

[b] X^2 values whose pr. $\geq$ .01

probability. Also reported are the differences between the conditions of each control variable and its probability of occurrence.

If an elaborated effect parameter has an associated positive value, pupil reading achievement performance was enhanced by the presence of the attribute in question. Of course, a negative value indicated that pupil performance was hampered.

TABLE 7

ELABORATION OF EFFECT PARAMETERS BY GRADE LEVEL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N = 1516	Grade Level Effect Parameters: Four N-537 a_{i_1}	Five N-616 a_{i_2}	Six N-363 a_{i_3}	Original Effect Parameter Elaborated by Grade Level: $A_i-a_{i_1}$	$A_i-a_{i_2}$	$A_i-a_{i_3}$	Intra-Grade Level Parameter Analysis: $a_{i_1}-a_{i_2}$	$a_{i_1}-a_{i_3}$	$a_{i_2}-a_{i_3}$
Reading	+.178[a]	+.010	+.078	+.095	.168[a]	.100	.083	.068	.085	.017
Pr	.0256	.4562	.1949	.1210	.0968	.2177	.2483	.2981	.2420	.4443
Mathematics	+.043	-.033	+.052	+.044	.076	.009	.001	.085	.077	.008
Pr	.3192	.3594	.2843	.2946	.2776	.3980	.4960	.2546	.2643	.4721
Food Services	+.026	+.040	-.003	-.011	.014	.029	.037	.043	.051	.008
Pr	.3859	.3300	.4880	.4443	.4602	.4090	.3821	.3707	.3372	.4721
Health Services	-.034	-.017	-.009	-.014	.051	.025	.020	.006	.063	.005
Pr	.3557	.4247	.4641	.4325	.3446	.4247	.4364	.4801	.4920	.4840
Elementary Counseling	+.031	+.031	-.038	+.048	.001	.069	.017	.068	.018	.086
Pr	.3669	.3707	.3372	.2776	.4681	.2946	.4443	.2981	.4404	.2389

[a] $p_{r.} \geq .10$

TABLE 8

ELABORATION OF EFFECT PARAMETERS BY INTELLIGENCE LEVEL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1516	Intelligence Level Effect Parameter High N=419 A_{i_1}	Mid N=514 A_{i_2}	Low N=583 A_{i_3}	Original Effect Parameter Elaborated by Intelligence Level $A_i - a_{i_1}$	$A_i - a_{i_2}$	$A_i - a_{i_3}$	Intra Intelligence Level Parameter Analysis $a_{i_1} - a_{i_2}$	$a_{i_1} - a_{i_3}$	$a_{i_2} - a_{i_3}$
Reading	+.178[a]	+.049	+.128[a]	+.067	.129	.050	.111	.079	.018	.061
Pr	.0256	.2843	.0694	.1977	.1515	.3446	.1788	.2611	.4404	.3015
Mathematics	+.043	+.008	+.070	-.115[a]	.035	.027	.158[a]	.062	.123	.185[a]
Pr	.3192	.4641	.2090	.0721	.3897	.4168	.0951	.3050	.1469	.0571
Food Service	+.026	+.011	-.017	-.051	.015	.043	.077	.028	.062	.034
Pr	.3859	.4483	.4207	.2578	.4522	.3669	.2611	.4090	.2981	.3859
Health Services	-.034	-.016	-.066	+.074	.018	.032	.109	.050	.090	.144
Pr	.3357	.4286	.2236	.1736	.443	.4013	.1814	.3409	.2206	.1093
Elementary Counseling	+.031	+.043	+.069	-.068	.012	.038	.099	.026	.111	.137
Pr	.3669	.3085	.2119	.1922	.4602	.3821	.2061	.4168	.1711	.1210

[a] $p_r. \geq .10$

TABLE 9

ELABORATION OF EFFECT PARAMETERS BY POVERTY LEVEL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1516	Poverty Level Effect Parameters High N=746 a_{i_1}	Low N=770 a_{i_2}	Original Effect Elaborated by Poverty Level $A_i - a_{i_1}$	$A_i - a_{i_2}$	Intra-Poverty Level Parameter Elaboration $a_{i_1} - a_{i_2}$
Reading	+.178[a]	+.154[a]	+.025	.024	.153	.129
Pr	.0256	.0630	.3936	.4286	.1210	.1736
Mathematics	+.043	+.040	+.003	.003	.040	.037
Pr	.3192	.3446	.4880	.4920	.3783	.3936
Food Services	+.027	+.079	-.052	.053	.078	.131
Pr	.3859	.2177	.2877	.3483	.2743	.1685
Health Services	-.034	-.013	-.018	.021	.016	.005
Pr	.3557	.4483	.4277	.4404	.4522	.4840
Elementary Counseling	+.031	+.036	-.004	.005	.035	.040
Pr	.3669	.3594	.4840	.4840	.3936	.3859

[a] Pr. $\geq$ .10

TABLE 10

ELABORATION OF EFFECT PARAMETERS BY
RACIAL ISOLATION LEVEL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1516	Racial Isolation Effect Parameter High N=944 a_{i_1}	Racial Isolation Effect Parameter Low N=572 a_{i_2}	Original Effect Parameter Elaborated by Racial Isolation $A_i - a_{i_1}$	Original Effect Parameter Elaborated by Racial Isolation $A_i - a_{i_2}$	Intra Racial Isolation Parameter Analysis $a_{i_1} - a_{i_2}$
Reading	+.178	+.109	+.071	.069	.107	.038
Pr	.0256	.1379	.1587	.2981	.1762	.3707
Mathematics	+.043	+.069	-.026	.026	.069	.095
Pr	.3192	.2266	.3594	.4207	.2743	.2061
Food Services	+.026	+.047	-.023	.021	.049	.070
Pr	.3859	.3050	.3745	.4364	.3372	.2709
Health Services	-.034	-.039	+.007	.005	.041	.041
Pr	.3557	.3372	.4602	.4840	.3794	.3446
Elementary Counseling	+.031	+.041	-.012	.010	.043	.053
Pr	.3669	.3264	.4325	.4681	.3557	.3228

[a] Pr. $\geq$ .10

TABLE 11

ELABORATION OF EFFECT PARAMETERS BY
ACHIEVEMENT ENTRY LEVEL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter	Achievement Entry Level Effect Parameters		Original Effect Parameter Elaborated by Achievement Entry Level		Intra Achievement Entry Level Parameter Analysis
	A_i N=1516	$\geq 1.0 < 2.0$ N=752	≥ 2.0 N=764			
		a_{i_1}	a_{i_2}	$A_i - a_{i_1}$	$A_i - a_{i_2}$	$a_{i_1} - a_{i_2}$
Reading	+.178[a]	+.040	+.126[a]	.138	.052	.086
Pr	.0256	.3446	.0968	.1515	.3482	.2676
Mathematics	+.043	+.026	+.017	.017	.026	.009
Pr	.3192	.3974	.4286	.4483	.4207	.4721
Food Services	+.026	+.084	-.057	.058	.083	.147
Pr	.3859	.1977	.2776	.336	.2643	.1446
Health Services	-.034	-.041	+.005	.007	.039	.046
	.3557	.3409	.4801	.4801	.3859	.3707
Elementary Counseling	+.031	+.031	-.027	.023	.058	.085
Pr	.3669	.2776	.3897	.4325	.3300	.2676

[a] Pr. $\geq$ .10

TABLE 12

EFFECT PARAMETERS BY
SCHOOL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1516	Schools									
		A N=57 a_{i_1}	B N=101 a_{i_2}	C N=96 a_{i_3}	D N=53 a_{i_4}	E N=77 a_{i_5}	F N=164 a_{i_6}	G N=101 a_{i_7}	H N=70 a_{i_8}	I N=142 a_{i_9}	J N=135 $a_{i_{10}}$
Reading Pr	+.178[a] .0256	+.023 .2546	+.024 .3264	-.033 .2946	+.027 .2236	-.031 .3192	+.039 .2119	-.052 .2389	+.040 .1292	+.063[a] .0526	+.081[a] .0307
Mathematics Pr	+.043 .3192	+.007 .4207	+.018 .3669	+.028 .3228	+.016 .3264	+.017 .3974	+.019 .3843	+.064 .1922	+.007 .4207	+.005 .4483	-.043 .1611
Food Services Pr	+.026 .3859	-.017 .3121	+.034 .2611	-.002 .4880	-.017 .3156	+.054 .2090	+.008 .4364	+.033 .3264	-.014 .3446	+.005 .4483	+.030 .2451
Health Services Pr	-.034 .3557	+.004 .4522	+.017 .3745	-.007 .4522	-.006 .4325	-.004 .4761	-.014 .3859	-.005 .4721	+.021 .2776	-.013 .3707	-.002 .4801
Elementary Counseling Pr	+.031 .3669	+.031 .1922	+.002 .4960	-.012 .4207	+.020 .2877	+.028 .3372	+.011 .4129	+.026 .3632	+.012 .3669	-.005 .4483	-.013 .3821

[a] Pr. $\geq$ .10

TABLE 13

ELABORATION OF EFFECT PARAMETERS BY
SCHOOL FOR READING ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i	Original Effect Parameters Elaborated by School									
		A $\lvert A_i - a_{i_1} \rvert$	B $\lvert A_i - a_{i_2} \rvert$	C $\lvert A_i - a_{i_3} \rvert$	D $\lvert A_i - a_{i_4} \rvert$	E $\lvert A_i - a_{i_5} \rvert$	F $\lvert A_i - a_{i_6} \rvert$	G $\lvert A_i - a_{i_7} \rvert$	H $\lvert A_i - a_{i_8} \rvert$	I $\lvert A_i - a_{i_9} \rvert$	J $\lvert A_i - a_{i_{10}} \rvert$
Reading Pr	+.178[a] .0256	.155[a] .0559	.154[a] .0721	.201[a] .0329	.151[a] .0618	.209[a] .0322	.139[a] .0901	.230[a] .0244	.138[a] .0793	.115 .1230	.097 .1660
Mathematics Pr	+.043 .3192	.036 .3557	.025 .4032	.015 .4443	.027 .3897	.026 .4090	.004 .4840	.021 .4826	.036 .3557	.038 .3520	.086 .1949
Food Services Pr	+.026 .3859	.043 .3300	.008 .4861	.028 .3974	.043 .3300	.028 .4013	.010 .4602	.007 .4761	.040 .3409	.021 .4168	.016 .4364
Health Services Pr	-.034 .3557	.038 .3483	.017 .4364	.027 .4013	.028 .3859	.030 .3936	.005 .4801	.029 .4013	.056 .2843	.021 .4168	.032 .3745
Elementary Counseling Pr	+.031 .3669	.001 .4960	.030 .3859	.043 .3483	.011 .4562	.003 .4880	.009 .4641	.005 .4840	.019 .4247	.036 .3994	.044 .3300

[a] $Pr. \geq .10$

Summary of the Elaboration of the Original Effect Parameters by Control Variable for Reading Achievement

The statistically significant results of the elaboration of the program attribute effect parameters are reported in Table 14. Only those values significant at the $\geq$ .10 are reported. The table is presented program attribute by control variable condition. This summary table allows one to examine the results of this analysis in a more total framework.

The following evidence is clear when one inspects the table entries.

(1) The supportive services (food services, health services, and elementary counseling) had no statistically significant impact on the reading achievement of those pupils who received services.

(2) Among low intelligence enrollees, the mathematics program component was associated with a diminishing effect on participating pupils' reading achievement.

(3) Pupils who participated in the reading program component seemingly were positively affected by that participation in terms of improvement in their reading achievement. This was especially true of pupils possessing a measured intelligence

TABLE 14

SUMMARY OF SIGNIFICANT PROGRAM EFFECT PARAMETERS AND ELABORATED EFFECT PARAMETERS BY CONTROL VARIABLE CONDITIONS FOR READING ACHIEVEMENT

Pupil Control Variable by Variable Condition	Effect Parameters of Program Attributes				
	Reading a_1	Mathematics a_2	Food Services a_3	Health Services a_4	Elementary Counseling a_5
Grade Level					
Four	+.010[b]				
Five					
Six					
Intelligence					
High					
Mid	+.128[a]	-.115[c]			
Low					
Poverty					
High	+.154[a]				
Low					
Racial Isolation					
High					
Low					
Achievement Entry Level					
$\geq 1.0 < 2.0$					
≥ 2.0	+.126[a]				
School					
A	+.023[b]				
B	+.024[b]				
C	-.033[b]				
D	+.027[b]				
E	-.031[b]				
F	+.039[b]				
G	-.052[b]				
H	+.040[b]				
I	+.063[a]				
J	+.081[a]				

[a]Effect parameters which are significantly different from zero (pr. $\geq$.10) but are not significantly different from the original effect parameter (pr. $\geq$.10).

TABLE 14

(continued)

[b]Effect parameters which are not significantly different from zero (pr. $\geq$ .10) but are significantly different from the original effect parameter (pr. $\leq$ .10).

[c]Effect parameters which are significantly different from zero (pr. $\geq$ .10) and also significantly different from the original effect parameter (pr. $\leq$ .10).

of a middle range and for pupils who attended schools which were associated with attendance tracts with large numbers of ADC recipients. The finest focus on this improvement surfaced when individual schools were examined. Pupils attending two of the ten schools were examined. Pupils attending two of the ten schools included in this elaboration analysis were significantly and positively affected by participation in the reading program component in terms of improvement in their reading achievement.

Analysis of Effect Parameters for Program Attributes on Mathematics Achievement

The mathematics computations achievement of participating pupils was analyzed by the same procedures as employed in the analysis of the reading achievement data. This analysis is outlined in the previous section. Each participating pupil was classified as to the number of types of program components in which that pupil had participated. Pupils within each program component combination were classified as attaining or not attaining the achievement success criterion and effect parameters for the program attributes computed. These effect parameters as well as their

probability values are reported in Table 15.

TABLE 15

EFFECT PARAMETERS FOR PROGRAM ATTRIBUTES
ON MATHEMATICS COMPUTATION ACHIEVEMENT

	Program Attributes				
	Reading a_1	Mathematics a_2	Food Services a_3	Health Services a_4	Elementary Counseling a_5
Effect	-.197	+.272	-.078	-.063	+.085
Pr. (a_i-0)	.0104	.0007	.1814	.2296	.1587

Pr. = $\leq$.10

The effect parameter analysis for program attributes indicates that the reading and mathematics attributes were associated with a statistically significant impact on achievement. Participation in the reading program component was associated with a diminished (-.197) pupils' improvement level in mathematics computation achievement. Enrollment in the mathematics component was associated with a positive or enhancing effect on participating pupils' mathematics computation achievement. Supportive services (food, health, and elementary counseling) were not significantly associated with improvement in mathematics computation achievement.

These results indicate that an underachieving pupil, in terms of mathematics computation, has more of a chance of improving that achievement level if he participates in the mathematics program component. A pupil who needs mathematics computation instructional assistance is not

likely to be able to improve computation skills achievement if he participates in the reading program component. The pupil may suffer from neglect.

Results of the Testing of the Independence of Control Variables for Mathematics Computation Achievement

As outlined previously and performed in the first section of this Chapter, the main effect parameter in both reading and mathematics computational achievement would be further elaborated by control variables. These variables are: (1) the entering achievement level of the participating pupils, (2) participating pupils' grade level enrollment, (3) participating pupils' measured intelligence, (4) the degree of racial isolation (number of Black enrollees) of participating pupils' schools, (5) the degree of poverty (ADC caseload membership) of participating pupils' schools, and (6) the schools participating pupils attended. These variables were explicated in Chapter III and the rationale for their use is contained in Chapter I.

These control variables in the mathematics achievement analysis were tested for independence via the previously discussed chi-square technique. The chi-square values obtained are reported in Table 16. The decision rule employed for the reading data analysis (pr. $\geq .01$) was also employed for this analysis.

The warning issued in the reading results section of this Chapter also holds in this instance. The above sets of variables are not independent and could result from a antecedent condition. Data

TABLE 16

CHI-SQUARE VALUES OF CONTROL VARIABLES FOR MATHEMATICS COMPUTATION ACHIEVEMENT[a]

Control Variable					
(1) Grade Level	-	92.97 df=4	48.93 df=2	2.02 df=2	.65 df=2	87.44[b] df=18
(2) Intelligence		-	1.76 df=2	7.10 df=2	1.68 df=2	85.26[b] df=18
(3) Entering Achievement			-	2.07 df=1	.04 df=1	23.50[b] df=9
(4) Racial Isolation				-	1.79 df=1	54.07b df=1
(5) Poverty Level					-	42.60[b] df=1
(6) School						-

[a] pr. $\geq$ .01

[b] X^2 value pr. $\geq$ .01

The tabled chi-square data indicate that again seven of the fifteen pairs of control variables were statistically significantly related:

Grade Level with Intelligence	92.97	4
Grade Level with Entering Achievement Level	48.93	2
Grade Level with each School	87.44	18
Intelligence with each School	85.76	18
Entering Achievement with each School	23.50	9
Racial Isolation with each School	54.07	1
Poverty Level with each School	42.60	1

interpretation will be somewhat restricted by this lack of independence.

Elaboration of Effect Parameters by Control Variable for Mathematics Computation Achievement

This elaboration procedure was described previously and further delineated in the first section of this Chapter. This analysis will also be presented by control variable. The following decision-rules will again be employed:

(1) Effect parameters were considered to be greater than zero if their probability value was $\geq$ .10 by a two-tailed test for significance.

(2) Differences between effect parameter values were considered to be greater than zero if their probability value was $\geq$ .10 by a two-tailed test for significance.

If an elaborated effect parameter has an associated positive value, pupil mathematics computational achievement performance was enhanced by the presence of the attribute in question. Of course, a negative value indicated that pupil performance was hampered.

TABLE 17

ELABORATION OF EFFECT PARAMETERS BY GRADE LEVEL FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1181	Grade Level Effect Parameters Four N=382 A_{i_1}	Five N=479 A_{i_2}	Six N=320 A_{i_3}	Original Effect Parameters Elaborated by Grade Level $A_i - a_{i_1}$	$A_i - a_{i_2}$	$A_i - a_{i_3}$	Intra Grade Level Parameter Analysis $a_{i_1} - a_{i_2}$	$a_{i_1} - a_{i_3}$	$a_{i_2} - a_{i_3}$
Reading	-.197[a]	-.019	-.088	-.071	.178[a]	.109	.126	.069	.052	.017
Pr	.0104	.3936	.1093	.1562	.0537	.1535	.1271	.2451	.3015	.4325
Mathematics	+.272[a]	+.108[a]	+.098[a]	+.066	.164[a]	.174[a]	.206[a]	.010	.042	.032
Pr	,.0007	.0630	.0838	.1736	.0681	.0594	.0344	.4602	.3372	.3745
Food Services	-.078	-.035	-.039	-.017	.043	.039	.067	.004	.018	.022
Pr	.1814	.2085	.2912	.4052	.3483	.3632	.2709	.4840	.4286	.4207
Health Services	-.063	-.043	-.037	+.046	.020	.026	.109	.006	.089	.083
Pr	.2296	.2709	.3015	.2578	.4236	.4090	.1611	.4761	.1841	.2033
Elementary Counseling	+.085	+.037	+.010	+.036	.048	.075	.049	.027	.001	.026
Pr	.1587	.2981	.4443	.3050	.3336	.2514	.3300	.3936	.4960	.3974

[a]Pr. $\geq$ .10

TABLE 18

ELABORATION OF EFFECT PARAMETERS BY INTELLIGENCE LEVEL FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1181	Intelligence Level Effect Parameter High N=207 a_{i_1}	Mid N=365 a_{i_2}	Low N=609 a_{i_3}	Original Effect Parameter Elaborated by Intelligence Level $A_i-a_{i_1}$	$A_i-a_{i_2}$	$A_i-a_{i_3}$	Intra Intelligence Level Parameter Analysis $a_{i_1}-a_{i_2}$	$a_{i_1}-a_{i_3}$	$a_{i_2}-a_{i_3}$
Reading	-.197[a]	-.009	-.028	-.135[a]	.188[a]	.169[a]	.062	.019	.126	.107
Pr	.0104	.4286	.3520	.0329	.0294	.0655	.2912	.4247	.1314	.1711
Mathematics	+.262[a]	+.051	+.113[a]	+.106[a]	.221[a]	.139	.166[a]	.062	.051	.007
Pr	.0007	.1611	.0606	.0735	.0132	.1075	.0708	.2676	.3264	.4761
Food Services	-.078	-.065	+.022	-.033	.013	.056	.045	.087	.032	.055
Pr	.1814	.1038	.3821	.3264	.4483	.3085	.3446	.1922	.3859	.3121
Health Services	-.063	+.035	+.057	-.106a	.098	.120	.043	.022	.141	.163
Pr	.2296	.2483	.2177	.0735	.1635	.1423	.3520	.4129	.1038	.0735
Elementary Counseling	+.085	+.013	+.057	+.014	.072	.022	.071	.044	.001	.043
Pr	.1587	.4013	.2177	.4443	.2358	.4207	.2643	.3300	.4960	.3632

[a] Pr. $\geq$ .10

TABLE 19

ELABORATION OF EFFECT PARAMETERS BY ENTERING
ACHIEVEMENT LEVEL FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter	Original Effect Parameters Elaborated by Entering Achievement Level				Intra Entering Achievement Level Parameter Analysis
		Entering Achievement Level Effect Parameters				
	A_i N = 1181	$\geq$ 1.0 $<$ 2.0 N=569	$\geq$ 2.0 N=612			
		a_{i_1}	a_{i_2}	$A_i - a_{i_1}$	$A_i - a_{i_2}$	$a_{i_1} - a_{i_2}$
Reading	-.197[a]	-.158[a]	-.015	.039	.182[a]	.143
Pr	.0104	.0307	.4207	.3745	.0537	.1020
Mathematics	+.272[a]	+.209[a]	+.063	.063	.209[a]	.146[a]
Pr	.0007	.0068	.1977	.3015	.0322	.0985
Food Services	-.078	+.104	-.045	.026	.033	.149[a]
Pr	.1814	.1093	.2743	.4129	.3859	.0934
Health Services	-.063	-.050	+.018	.013	.081	.068
Pr	.2296	.2776	.4052	.4562	.2358	.2743
Elementary Counseling	+.085	+.078	+.007	.007	.078	.071
Pr	.1587	.1788	.4641	.4761	.2451	.2643

[a] Pr. $\geq$ .10

TABLE 20

ELABORATION OF EFFECT PARAMETERS BY RACIAL LEVEL ISOLATION FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter	Racial Isolation Effect Parameter		Original Effect Parameters Elaborated by Racial Isolation		Intra Racial Isolation Parameter Analysis
	A_i N=1181	High N=614 a_{i_1}	Low N=567 a_{i_2}	$A_i - a_{i_1}$	$A_i - a_{i_2}$	$a_{i_1} - a_{i_2}$
Reading	-.197[a]	-.144	-.047	.053	.150[a]	.097
Pr	.0104	.1170	.2451	.3594	.0853	.2420
Mathematics	+.272[a]	+.236[a]	+.060	.036	.212[a]	.176
Pr	.0007	.0250	.1867	.4052	.0262	.1020
Food Services	-.078	-.056	-.048	.022	.030	.008
Pr	.1814	.3192	.2420	.4404	.3936	.4761
Health Services	-.063	-.005	-.003	.058	.060	.002
Pr	.2296	.3372	.4840	.3843	.2912	.4960
Elementary Counseling	+.085	+.080	-.014	.005	.099	.094
Pr	.1587	.2546	.4207	.4880	.1841	.2483

[a] Pr. $\leq$ .10

TABLE 21

ELABORATION OF EFFECT PARAMETERS BY POVERTY LEVEL FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter	Poverty Level Effect Parameters		Original Effect Parameters Elaborated by Poverty Level		Intra Poverty Level Parameter Analysis
		High N=601	Low N=580			
	A_i	a_{i_1}	a_{i_2}	$A_i - a_{i_1}$	$A_{i_1} - a_{i_2}$	$a_{i_1} - a_{i_2}$
Reading	-.197	-.111[a]	-.054	.086	.143	.057
Pr	.0104	.0985	.2296	.2389	.1020	.3085
Mathematics	+.272	+.254[a]	-.012	.018	.284[a]	.266[a]
Pr	.0007	.0016	.4364	.4404	.0059	.0096
Food Services	-.078	-.010	-.061	.068	.017	.051
Pr	.1814	.4522	.2033	.2877	.4404	.3264
Health Services	-.063	-.004	-.035	.059	.028	.031
Pr	.2296	.4801	.3156	.3156	.4013	.3936
Elementary Counseling	+.085	+.116[a]	-.024	.031	.109	.140
Pr	.1587	.0901	.3707	.4013	.1660	.1093

[a] Pr. $\leq$ .10

TABLE 22

EFFECT PARAMETERS BY SCHOOL FOR
MATHEMATICS COMPUTATION ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i N=1181	Schools									
		A N=45 a_{i_1}	B N=80 a_{i_2}	C N=77 a_{i_3}	D N=58 a_{i_4}	F N=48 a_{i_5}	F N=163 a_{i_6}	G N=58 a_{i_7}	H N=63 a_{i_8}	I N=96 a_{i_9}	J N=93 $a_{i_{10}}$
Reading Pr	-.197[a] .0104	+.016 .2743	-.013 .3669	-.063[a] .0571	+.025 .2877	+.015 .3669	-.040 .2451	+.012 .3859	-.022 .2177	-.059[a] .0823	-.034 .2296
Mathematics Pr	+.272[a] .0007	+.040[a] .0655	+.037 .1685	+.062[a] .0606	+.043 .1685	+.004 .4641	+.087[a] .0681	-.002 .4801	+.015 .2981	+.041 .1660	+.047 .1515
Food Services Pr	-.078 .1814	-.053[a] .0228	-.010 .3974	+.008 .4207	+.007 .4364	+.042 .1736	+.022 .3520	+.004 .4602	-.015 .2981	-.015 .3632	+.012 .3974
Health Services Pr	-.063 .2296	+.002 .4681	-.004 .4602	+.022 .2912	-.015 .3669	+.003 .4721	-.002 .4880	-.006 .4404	-.015 .2981	+.001 .4920	-.015 .3707
Elementary Counseling Pr	+.085 .1587	+.013 .3121	+.010 .3974	+.025 .2643	+.034 .2736	+.013 .3859	+.013 .4129	+.017 .3409	-.003 .4562	+.013 .3783	+.019 .3372

[a] Pr. $\geq$ .10

TABLE 23

ELABORATION OF EFFECT PARAMETERS BY SCHOOL FOR
MATHEMATICS COMPUTATIONS ACHIEVEMENT

Program Attribute	Original Effect Parameter A_i	Original Effect Parameters Elaborated by School									
		A $\lvert A_i-a_{i_1}\rvert$	B $\lvert A_i-a_{i_2}\rvert$	C $\lvert A_i-a_{i_3}\rvert$	D $\lvert A_i-a_{i_4}\rvert$	E $\lvert A_i-a_{i_5}\rvert$	F $\lvert A_i-a_{i_6}\rvert$	G $\lvert A_i-a_{i_7}\rvert$	H $\lvert A_i-a_{i_8}\rvert$	I $\lvert A_i-a_{i_9}\rvert$	J $\lvert A_i-a_{i_{10}}\rvert$
Reading	-.197[a]	.213[a]	.184[a]	.134[a]	.222[a]	.212[a]	.157[a]	.209[a]	.175[a]	.138[a]	.163[a]
Pr	.0104	.0087	.0250	.0778	.0107	.0139	.0643	.0139	.0262	.0735	.0465
Mathematics	+.272[a]	.232[a]	.235[a]	.210[a]	.229[a]	.268[a]	.185[a]	.274[a]	.257[a]	.231[a]	.225[a]
Pr	.0007	.0047	.0060	.0129	.0087	.0027	.0367	.0019	.0021	.0078	.0102
Food Services	-.078	.025	.068	.086	.085	.120	.100	.082	.063	.063	.090
Pr	.1814	.3897	.2358	.1814	.1894	.1075	.1660	.1949	.2420	.2546	.1762
Health Services	-.063	.065	.059	.085	.048	.066	.061	.057	.048	.064	.048
Pr	.2296	.2327	.2643	.1841	.3085	.2483	.2776	.2743	.2981	.2514	.3121
Elementary Counseling	+.085	.072	.075	.060	.051	.072	.072	.068	.088	.072	.066
Pr	.1587	.2090	.2119	.2611	.2981	.2266	.2420	.2358	.1635	.2266	.2483

[a]Pr. $\geq$ .10

TABLE 24

SUMMARY OF SIGNIFICANT PROGRAM EFFECT PARAMETERS AND ELABORATED EFFECT PARAMETERS BY CONTROL VARIABLE CONDITIONS FOR MATHEMATICS COMPUTATION ACHIEVEMENT

Control Variable by Variable Condition	Effect Parameters of Program Attributes				
	Reading a_1	Mathematics a_2	Food Services a_3	Health Services a_4	Elementary Counseling a_5
Grade Level					
Four	+.019[b]	+.108[c]			
Five		+.098[c]			
Six		+.066[b]			
Intelligence					
High	-.009[b]	+.051[b]			
Mid	-.028[b]	+.113[a]			
Low	-.135[a]	+.106[c]		-.106[a]	
Poverty					
High	-.111[a]	+.254[a]			+.116[a]
Low		-.012[b]			
Racial Isolation					
High		+.236[a]			
Low	-.047[b]	+.060[b]			
Achievement Entry Level					
$\geq$ 1.0 $<$ 2.0	-.158[a]	+.209[a]			
$\geq$ 2.0	-.015[b]	+.063[b]			
School					
A	+.016[b]	+.040[c]	-.053[a]		
B	-.013[b]	+.037[b]			
C	-.063[c]	+.062[c]			
D	+.025[b]	+.043[b]			
E	+.015[b]	+.004[b]			
F	-.040[b]	+.087[c]			

TABLE 24

(continued)

Control Variable by Variable Condition	Effect Parameters of Program Attributes				
	Reading a_1	Mathematics a_2	Food Services a_3	Health Services a_4	Elementary Counseling a_5
School					
G	$+.012^b$	$-.002^b$			
H	$-.022^b$	$+.015^b$			
I	$-.059^c$	$+.041^b$			
J	$-.034^b$	$+.047^b$			

[a]Effect parameters which are significantly different from zero (pr. $\geq$ .10) but not significantly different from the original effect parameter (pr. $\geq$ .10).

[b]Effect parameters which are not significantly different from zero (pr. $\geq$ .10) but are significantly different from the original effect parameter (pr. $\geq$ .10).

[c]Effect parameters which are significantly different from zero (pr. $\geq$ .10) and also significantly different from the original effect parameter (pr. $\geq$ .10).

with mid or low intelligence, pupils enrolled in schools within areas of high poverty or high racial isolation, and among pupils who were classified as one year underachievers. Pupils ernolled in three select schools were most affected of all pupils.

(3) Participation in the mathematics improvement component had an enhancing effect on the mathematics computation achievement of pupils underachieving in mathematics. This enhancing effect was revealed in schools within areas of low racial isolation, and among pupils who were one year underachievers.

In addition, pupils attending a select two schools were most affected by all pupils.

Summary

This section has presented the analysis of the data germane to this investigation. Analyses for both reading and mathematics computations achievement were presented. Each analysis included the extraction of main effect parameters for each program attribute under investigation, a test for the independent of control variables, and the results of elaborating the main or original effect parameters by each of six control variables. These analyses indicated that both the reading and mathematics program components met the need for which they were designed. Elaboration analysis did demonstrate that various pupil groups were differently affected by these compensatory program components. Anomalies also surfaced. The limiting effect of the reading program on the mathematics computation achievement of reading component participants was of primary significance.

INTERPRETATION OF THE FINDINGS

Introduction

This section presents and discusses the interpretation of the results of the analysis of the data contained in Chapter IV. Limitations in the interpretation of the data are given, and suggestions for future research are made.

Summary and Interpretation of Previously Reported Results

This section presents an interpretation of the results of the analyses reported in the previous section. This section is organized around two presentations: (1) the results of the program attribute effect parameters for both achievement domains under study.

Results of the program attribute analysis . . . Table 25 contains a summary of the significant program attribute effect parameters. This analysis yielded three significant effect parameters; two in the mathematics computation achievement area and one in the domain of reading achievement. There is an apparent lack of effect associated with the program attributes termed supportive services: food services, health services, and elementary counseling. There is also the confounding effect associated with mathematics computation achievement

and participation in the reading program attribute (A_i = -.197). Participation in the mathematics program attribute did not seemingly hinder reading achievement. In fact, such participation was associated with advancement in reading achievement, although not significantly.

TABLE 25

SIGNIFICANT EFFECT PARAMETERS BY PROGRAM ATTRIBUTE AND ACHIEVEMENT AREA

Achievement Area	Program Attributes				
	Reading	Mathematics	Food Services	Health Services	Elementary Counseling
Reading	+.178				
Mathematics Computation	-.197	+.272			

The apparent reading achievement success of underachieving reading participants in the reading program attribute and a similar success of underachieving mathematics pupils in the mathematics program attribute are expected outcomes. These outcomes indicate that compensatory education program components designed to alter the achievement of underachieving pupils are successful, at least in the population used by this study. The instructional approach employed by the reading and mathematics improvement components of Columbus Ohio's compensatory education program may be the key for interpreting this success. Each component attempts to individualize instruction through the use of diagnostic testing and prescriptive learning activities. This

instructional approach is personalized by small group instruction, usually employing a pupil teacher ratio not exceeding 5-7 to 1. Diagnosing achievement weaknesses and prescribing specific types of learning activities on a small group and/or individual basis is considered an effective instructional approach. The fact that this study examines outcomes of these program components during the fourth year of their existence must be considered. Experience in the use of diagnostic measures, learning aids, and programmed instructional packages must also be considered as a significant input to this apparent success.

The lack of significant achievement success associated with the supportive services may also be interpreted by reflecting on each component's intents. Food service is intended to meet a nutritional need on the part of low-income pupils; health services is designed to provide medical and dental services to low-income pupils; and elementary counseling is a service intended to aid pupils with behavior problems in adjusting to the regular school routine. By fulfilling these needs, it was hypothesized by compensatory education planners that pupils would be more capable of benefiting from regular classroom instruction. Hence, these pupils should be able to learn more i.e., achieve at a more rapid rate. This is probably a valid hypothesis, though the data analysis of this study does not support such a premise.

These supportive services program components were not designed to directly affect achievement. Rather, the intent is one of improving readiness to learn. The effectiveness of these program components might not become readily apparent in the relatively brief duration of one year. In fact, the effect of any one year's participation on pupil achievement may not attain significant proportions. But, if the insignificant results of three single year's participation were summed, the result might be one of an educationally significant result. Possibly, the effect of these supportive services is maximized when a recipient of such service is also enrolled in a component which deals directly with pupil achievement concern, e.g., the previously discussed reading and mathematics components. It might not be valid to attempt to determine the effect of these supportive services on pupil achievement. It may be much more important that they contribute to a pupil's physiological and/or emotional well-being. It is perhaps justifiable that a school system should attempt to do more than merely improve the cognitive area of a child.

The unexpected result is the negative effect associated with mathematics computation achievement and participation in the reading program component. This anomaly is at best a considerable problem. Literature in this domain seemingly indicates that this outcome is unexpected. Romberg, in analyzing studies relating learner aptitudes and abilities to mathematics learning, summarized the research of the

relationship between mathematics and reading ability in the following manner:

> A number of investigators continue to study the relationship between mathematics and reading ability. Since mathematics has its own symbolism and syntatics, it requires its own reading skills. Several investigators (e.g., Smith and Heddons, 1964) employed readability formulas to analyze mathematics texts. Others (e.g., Kane and Hater, 1968) tired to adapt standard reading techniques to the readability of mathematical English. Call and Wiggin (1966) demonstrated that a ten-day unit on the reading of mathematic helped students to solve work problems. Surprisingly, Gilmary (1967) found that remedial reading instruction had a positive effect on arithmetical computation achievement.[1]

The other references cited seemingly indicated that a positive transfer of learning should occur between reading instruction and mathematics achievement.

There are other considerations, however. The negative mathematics achievement effect associated with participation in the reading component is determined in the analysis of mathematics computation achievement. All pupils in this analysis were achieving at least one year below grade level in mathematics computations. These pupils needed the services of the mathematics improvement component. Further, approximately one third of these pupils were only enrolled in the reading improvement component. It can be assumed that if a pupil received the services of the reading component that pupil was also

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[1]Thomas A. Romberg, "Current Research in Mathematics Education," in Review of Educational Research, Vol. 39, No. 4, October, 1969, p. 480.

achieving a year below grade level enrollment in reading vocabulary and/or reading comprehension. Thus in this instance, it is most likely that the pupils being analyzed were underachieving in both reading and mathematics computation.

These considerations present two alternative possibilities. First, pupils needed the instructional assistance of both the mathematics and reading improvement components but only received aid from the reading component. The second alternative is that pupils needed the assistance of both components and received assistance from both. The analysis technique employed in this study reveals the effect on mathematics computations achievement associated with participation in the reading component with the effects of all other component participation removed, including no participation in the reading component. Thus, the net effect associated with mathematics computation achievement and participation in the reading component is significantly negative. This is true whether or not the underachieving pupil participated in the mathematics component. The only reason for distinguishing between two different pupil populations involved in this result is that the implications of the result and subsequent recommendations for change or future study would vary for each pupil group.

It is almost certain that many of the underachieving mathematics pupils analyzed by the reading program attribute were underachieving

in both mathematics computation and reading vocabulary and/or reading comprehension. This negative effect on mathematics computation achievement is due to participation in the reading component *en toto*. Depending on the pupil group being discussed, any of the following interpretations could prove to be valid.

If a pupil received the services of both the mathematics and reading components, the net effect on total achievement could likely have been a series of checks on achievement. Enrollment in the mathematics component advanced mathematics computation achievement while enrollment in the reading component probably advanced reading achievement. However, for some reason, the enrollment in the reading component had a limiting effect on mathematics computation achievement. The net result was that the mathematics component was advancing this particular pupil population in computation skills while the reading component was reversing these advances faster than mathematics component was making them.

If a pupil, needing the services of both the reading and mathematics components, received only the services of the reading component, a different focus of discussion becomes apparent. It is easily predictable that if a pupil is achieving a year below grade level that pupil will most likely continue to fall farther behind unless a concentrated effort is made to correct the trend. In all likelihood, this was the case for many of the pupils examined in this study. They needed

specialized assistance and received none, either from the mathematics component or from their regular classroom teacher.

As previously mentioned, these interpretations could have been catalyzed by the instructional organization employed by the reading component. Also mentioned was the possibility that one or more pupil population parameters could account for the negative mathematics computation achievement effect associated with participation in the reading component.

Salient parameters associated with the pupil population under study will be explored in the following interpretation of the elaboration of the program attribute effect parameters. Interpretation of these results will be referenced to this negative effect problem when relevant.

Summary of Findings

(1) The Title I (ESEA) reading and mathematics components are significantly associated with pupil achievement success in reading and

mathematics computations respectively. The State Disadvantaged Pupil elementary counseling, food services, and health services components are not.

(2) When analyzed by intelligence level, the mathematics component is associated with mathematics achievement success among "low" and "mid-intelligence" pupils. The reading component is associated with reading achievement success among "mid-intelligence" pupils only. Neither component is associated with success among "high intelligence" pupils.

(3) Analysis by poverty level and racial enrollment of a school indicated that both the reading and mathematics components were associated with achievement success in schools with "high" levels of poverty and/or "high" enrollment of black pupils. The reading component is also associated with achievement success in schools classified as "low" on both the poverty and racial variables.

(4) Analysis by entering pupil achievement level indicate the mathematics component is associated with mathematics achievement success among one year underachievers but not two year underachievers. The reverse is true of the reading component.

(5) Analysis by grade level indicate that the mathematics component is associated with mathematics achievement success among fourth and fifth grade pupils but not sixth grade pupils. The reading component is associated with reading achievement success among fifth and sixth grade pupils but not fourth grade pupils.

(6) The successful achiever in reading and mathematics computations retained skills learned over a summer interim without formal instruction in those skills during that period of time.

(7) Analysis by school reveals that a wide range of variance exists among schools in the degree to which they are associated with either reading or mathematics achievement success.

(8) Pupils who are eligible to receive the services of the mathematics component but do not receive such services show a significant regression in mathematics achievement. This is also true of reading achievement among low intelligence pupils.

A summary of the significant elaborations of original effect parameters is contained in Table 32.

TABLE 32

SUMMARY OF SIGNIFICANT ELABORATIONS OF ORIGINAL EFFECT PARAMETERS BY PROGRAM ATTRIBUTE AND ACHIEVEMENT AREA WITHIN CONTROL VARIABLE

Control Variable	Achievement Area	Program Attribute: Reading	Mathematics	Food Services	Health Services	Elementary Counseling
Grade Level						
Four	Reading	+.010[b]				
	Mathematics	+.019[b]	+.108[c]			
Five	Reading					
	Mathematics		+.098[c]			
Six	Reading					
	Mathematics		+.066[b]			
Intelligence						
High	Reading					
	Mathematics	-.009[b]	+.051[b]			
Mid	Reading	+.128[a]				
	Mathematics	-.028[b]	+.113[a]			
Low	Reading		-.115[c]			
	Mathematics	-.135[a]	+.106[c]	-.106[a]		
Poverty						
High	Reading	+.154[a]				
	Mathematics	-.111[c]	+.254[a]			+.116[a]
Low	Reading					
	Mathematics		-.012[b]			
Racial Isolation						
High	Reading					
	Mathematics		+.236[a]			
Low	Reading					
	Mathematics	-.047[b]	+.060[b]			
Achievement Entry Level						
≥1.0 <2.0	Reading					
	Mathematics	-.158[a]	+.209[a]			
≥2.0	Reading	+.126[a]				
	Mathematics	-.015[b]	+.063[b]			

TABLE 32 CONT'D

Control Variable	Achievement Area	Program Attribute: Reading	Mathematics	Food Services	Health Services	Elementary Counseling
School						
A	Reading	+.023[b]				
	Mathematics	+.016[b]	+.040[c]	-.053[a]		
B	Reading	+.024[b]				
	Mathematics	-.013[b]	+.037[b]			
C	Reading	-.033[b]				
	Mathematics	-.063[c]	+.062[c]			
D	Reading	+.027[b]				
	Mathematics	+.025[b]	+.043[b]			
E	Reading	-.031[b]				
	Mathematics	+.015[b]	+.004[b]			
F	Reading	+.039[b]				
	Mathematics	-.040[b]	+.087[c]			
G	Reading	-.052[b]				
	Mathematics	+.012[b]	-.002[b]			
H	Reading	+.040[b]				
	Mathematics	-.022[b]	+.015[b]			
I	Reading	+.063[a]				
	Mathematics	-.059[c]	+.041[b]			
J	Reading	+.081[a]				
	Mathematics	-.034[b]	+.047[b]			

[a]Effect parameters which are significantly different from zero (pr. $\geq$.10) but not significantly different from the original effect parameter (pr. $\geq$.10).

[b]Effect parameters which are not significantly different from zero (pr. $\geq$.10)but are significantly different from the original effect parameter (pr. $\geq$.10).

[c]Effect parameters which are significantly different from zero (pr. $\geq$.10) and also significantly different from the original effect parameter (pr. $\geq$.10).

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